



Integrating seedling quality testing into reforestation programs

March 1, 2022



My Background:

- ▲ B.S. Forest Management from Washington State University
- ▲ Worked summers for USFS, Enumclaw WA
- ▲ 1990: Hired by Potlatch as Asst. Seedling Production Supervisor, Potlatch Greenhouse, Lewiston ID
- ▲ 1993: Promoted to Seedling Production Supervisor, Potlatch Greenhouse, Lewiston ID
- ▲ 2009: Potlatch Greenhouse permanently closed.
- ▲ 2009: Promoted to Silviculturist. Current duties include contract growing of seedlings, seedling delivery, seed procurement and sales, project management of research.



Overview:

- 🌲 Reforestation seedling goals?
- 🌲 Nursery locations?
- 🌲 How to monitor seedling crop at nurseries?
- 🌲 Types of tests available and where to get them?
- 🌲 How to integrate results – A case study
- 🌲 Conclusions



Reforestation seedling goals?

- 🌲 Seedlings:
 - 🌲 Healthy, balanced seedling:
 - 🌲 Good root mass.
 - 🌲 Good bud set.
 - 🌲 Above minimum and close to target specifications.
 - 🌲 Disease free.
 - 🌲 Packed at optimum time.
- 🌲 Delivered in optimum condition for planting.
- 🌲 Ideally, grown close to ownership.



Nursery locations?

- 🌲 Historically, a lot of nurseries were located near reforestation sites in north Idaho.
 - 🌲 Northwoods Nursery, Elk River ID – **CLOSED**
 - 🌲 Western Forest Systems, Lewiston ID – **CLOSED**
 - 🌲 Potlatch Greenhouse, Lewiston ID – **CLOSED**
 - 🌲 Pleasant Hills Nursery, Troy ID – **CLOSED**
- 🌲 Current local nurseries:
 - 🌲 Plants of the Wild, Tekoa WA
 - 🌲 Wildlife Habitat, Princeton ID
 - 🌲 Idaho Evergreens, Deary ID
 - 🌲 University of Idaho, Moscow



Nursery locations?

- 🌲 The larger your planting program, the further from ownership you may have to go.
- 🌲 Large scale nurseries are currently located at least 5-6 hours drive from Lewiston.
- 🌲 Scattered from N. California to southern BC.
- 🌲 West side vs. east side
- 🌲 Greenhouse vs. outdoor compound
- 🌲 High intensity lights?



How to monitor seedling crops from a distance?





How to monitor seedling crop at nurseries?

- 🌲 In person inspections.
 - 🌲 Big time commitment.
 - 🌲 US only right now.
 - 🌲 Best way.
- 🌲 Zoom meetings with pictures of seedling crops.
 - 🌲 OK substitution.
 - 🌲 Hard to get overall feel of crop.
- 🌲 FaceTime with actual walk through of crop.
- 🌲 Height/caliper measurements (scatter diagrams) throughout growth cycle.
- 🌲 Inventory of crop throughout growth cycle.
- 🌲 ***Testing seedlings.***



Tests available and where to get them?

🌲 Cold Hardiness Tests:

- 🌲 University of Idaho, Pitkin Forest Nursery

🌲 Root Growth Potential (RGP) Tests:

- 🌲 University of Idaho, Pitkin Forest Nursery

- 🌲 Some nursery locations



Cold Hardiness Testing





Cold Hardiness Test:

- ▲ Measure of seedling's ability to withstand freezing temperatures.
- ▲ Develops in tandem with chilling hours.
- ▲ If seedlings are not cold hardy may cause physiological and/or morphological damage while in freezer storage.
- ▲ High LT_{50} values (less negative) indicate seedlings are not cold hardy and likely do not have enough chilling hours.
- ▲ LT_{50} readings are recorded and compared with published values for each species.



Cold Hardiness Test:

- Historically tests were done by freezing entire seedling.
- Potlatch Greenhouse sent off Douglas-fir and western white pine samples every year for testing prior to harvest.
- However, testing facilities closed and no way to test until recently.
- University of Idaho, Pitkin Forest Nursery, has stepped in to fill this gap.



Cold Hardiness Test:

- ▲ Perform freeze-induced electrolyte leakage test (FIEL).
- ▲ At each decreasing temperature, the electrolyte concentration (EC) in water is measured to determine the % of electrolytes that leak out of the tissue.
- ▲ PotlatchDeltic test:
 - ▲ 9 seedlings per seedlot randomly selected.
 - ▲ Needles randomly selected, processed and subjected to decreasing temperatures.



Cold Hardiness Testing at Pitkin Nursery



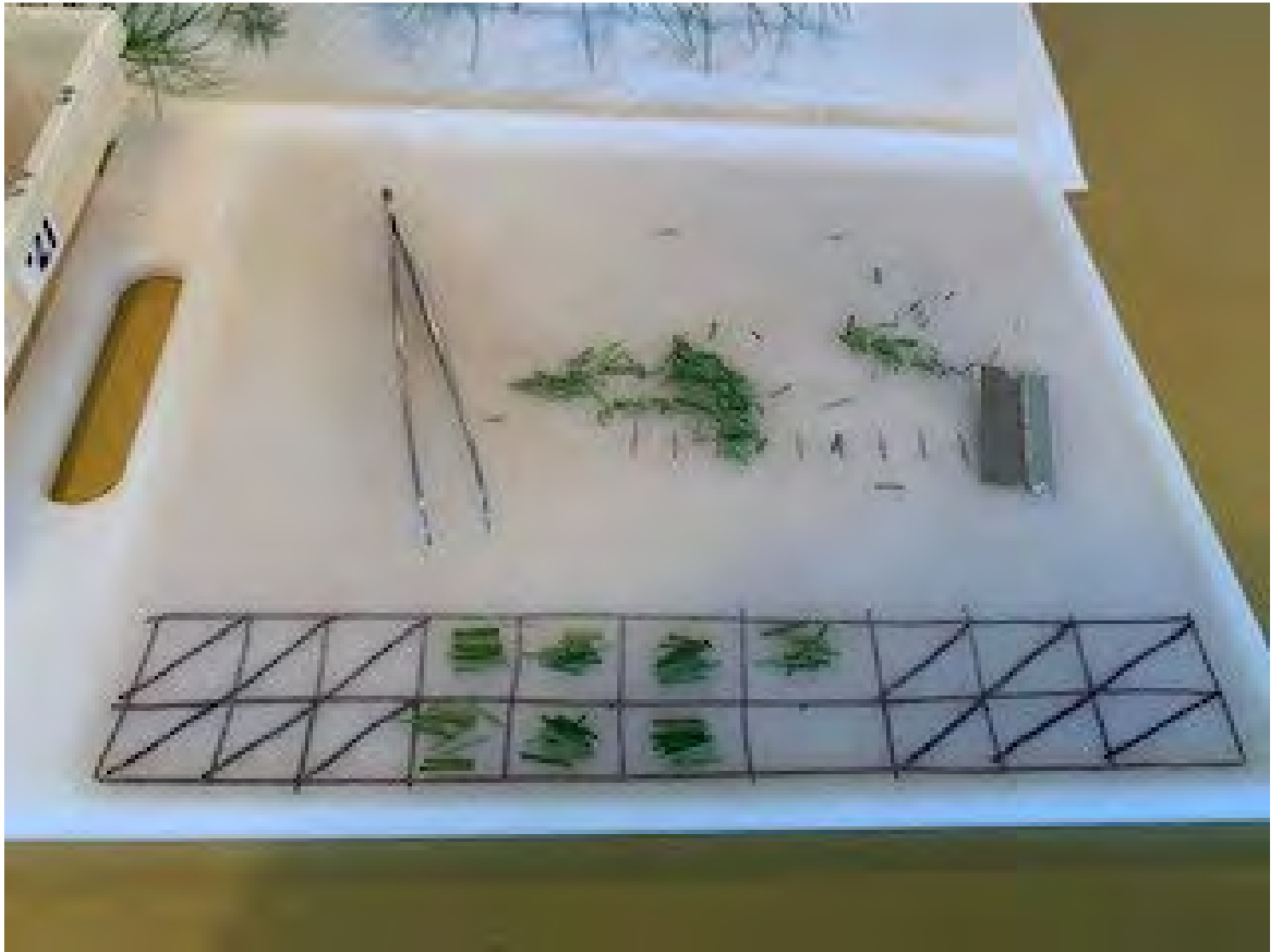


Cold Hardiness Testing at Pitkin Nursery





Cold Hardiness Testing at Pitkin Nursery





Cold Hardiness Testing at Pitkin Nursery





Cold Hardiness Testing at Pitkin Nursery



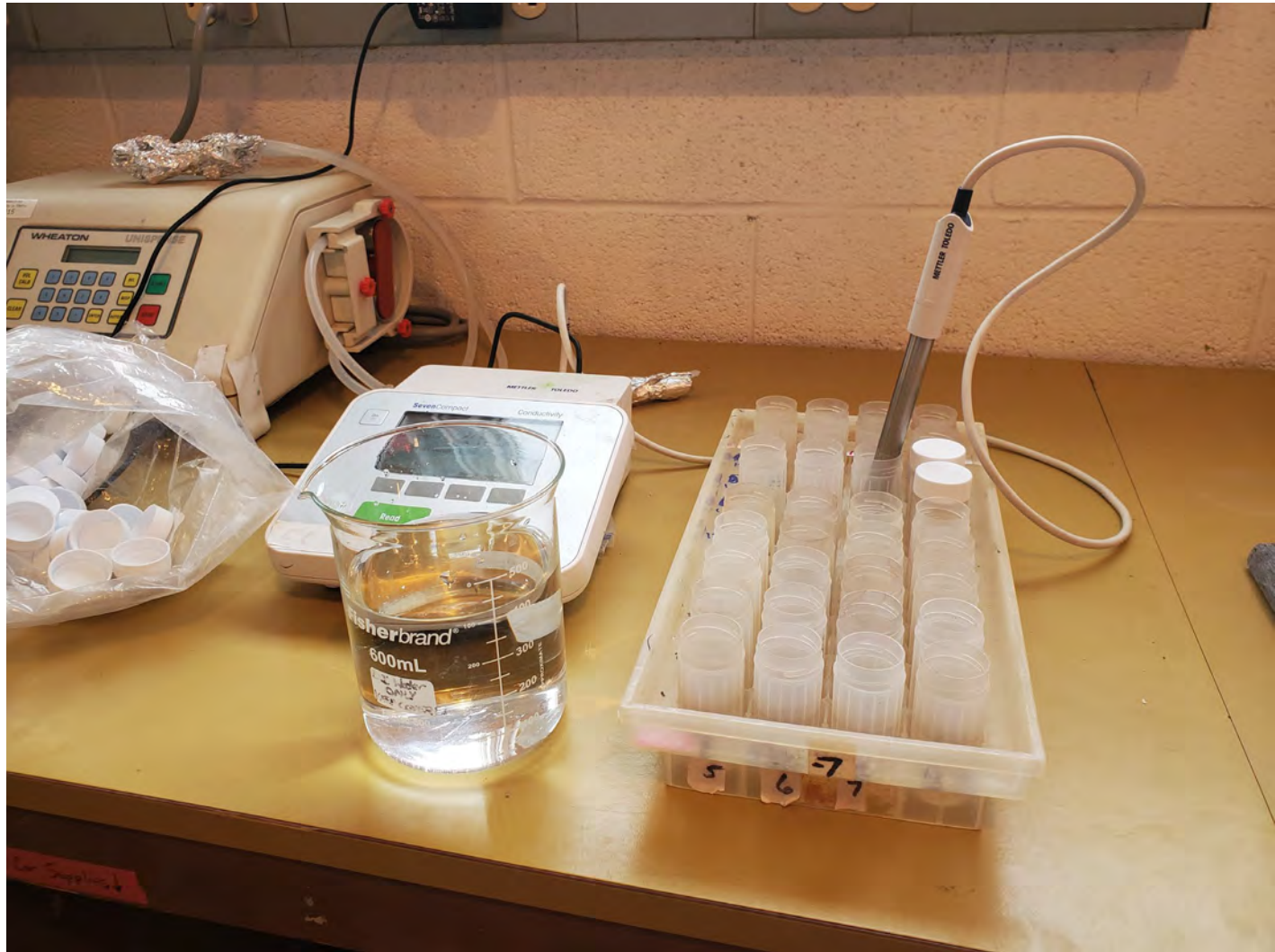


Cold Hardiness Testing at Pitkin Nursery





Cold Hardiness Testing at Pitkin Nursery





PotlatchDeltic Cold Hardiness Results:

LT50 Results					
Nursery	Species	Seedlot Elevation	Stocktype	2022 LT50 (°C)	2021 LT50 (°C)
Nursery A	DF	2500-3200	415C	-12.7	
Nursery C	DF	2500-3200	415C		-29.1
Nursery B	DF	3000-3700	412B	-12.0	
Nursery B	DF	3000-3700	410A		-17.8
Nursery F	DF	3000-3700	415C		-20.6
Nursery E	DF	3000-3700	411B		-28.3
Nursery E	DF	3000-3700	411B		-28.3
Nursery E	DF	3000-3700	411B		-37.6
Nursery C	DF	3100-3800	415C	-25.4	
Nursery A	DF	3100-3800	415C	-16.2	
Nursery D	DF	3100-3800	415C	-12.9	
Nursery E	DF	3300-4000	411B	-17.8	
Nursery C	DF	3300-4000	415C		-31.4
Nursery F	DF	4000-4700	415C	-19.7	
Nursery G	DF	4000-4700	415C	-15.1	
Nursery G	DF	4000-4700	415C		-34.3
Nursery H	DF	4000-4700	415C		-27.3
Nursery G	DF	4500-4800	415C	-14.2	
Nursery G	DF	4500-4800	415C		-21.0



Take Aways from Cold Hardiness Results:

- 🌲 Eight different nursery locations used to grow PotlatchDeltic Douglas-fir seedlings.
- 🌲 Four different block sizes used for Douglas-fir seedlings.
- 🌲 Cold hardiness varied by nursery location.
- 🌲 Cold hardiness varied by seedlot at same nursery location.

🌲	Nursery	Species	Seedlot Elevation	Stocktype	LT50 (°C)	LT50 (°F)
	Nursery A	DF	2500-3200	415C	-12.7	9.1
🌲	Nursery A	DF	3100-3800	415C	-16.2	2.8

- 🌲 Cold hardiness varies from year to year.



Take Aways from Cold Hardiness Results:

- 🌲 Use Cold Hardiness test results to:
 - 🌲 Fine tune your nursery seedlot allocation.
 - 🌲 Fine tune your nursery species allocation.
 - 🌲 Fine tune your nursery use.
 - 🌲 Confirm Chilling Hours calculation done by nursery.



RGP Testing





Root Growth Potential (RGP) Testing

- 🌲 Testing completed at UI Pitkin Nursery
- 🌲 Pitkin has established protocol for several species:
 - 🌲 75 seedlings randomly selected at nursery by seedlot for testing
 - 🌲 Shipped to Pitkin, freezer stored until testing.
 - 🌲 15 seedlings randomly selected and tested.
 - 🌲 Roots are washed
 - 🌲 Initial height, caliper and photo taken
 - 🌲 Placed in aeroponic chamber for testing (time varies by species)
 - 🌲 Final measurements include:
 - 🌲 Photo
 - 🌲 Longest root count
 - 🌲 Total root count



Root Growth Potential (RGP) Testing

- ▲ PotlatchDeltic has been working with Pitkin Nursery for 7 years on RGP Testing.
- ▲ The protocols and equipment have been improved to ensure quality results.
- ▲ Consistent nursery personal performing all tests.
- ▲ Photos and data supplied for each seedlot.



Root Growth Potential (RGP) Testing





Root Growth Potential (RGP) Testing





Root Growth Potential (RGP) Testing





Root Growth Potential (RGP) Testing

Species	Size (metric)	Date Received	Nursery Score	Average Root Count
DF	8	10-Dec		52.53
DF	8	1-Dec		49.73
DF	8	1-Dec		13.93
DF	8	2-Dec		57.93
DF	410A	4-Nov		24.07
DF	8	16-Dec		71.53
DF	411B	9-Dec	3.43	37.00
DF	411B	9-Dec	4.37	47.87
DF	411B	9-Dec	3.97	40.13
DF	8	10-Dec		33.33
DF	410A	16-Dec		20.20
DF	410A	21-Jan		33.20
DF	8	2-Dec		64.53
DF	8	16-Dec		47.53
DF	8	10-Dec		40.00
DF	8	2-Dec		51.27



Take Aways from RGP Results:

- 🌲 Intrinsically, more roots are better.
- 🌲 However, how many roots do seedlings really need to perform well after planting?
- 🌲 In order to link RGP results to field performance, outplantings are done each spring, and measurements taken each fall.
- 🌲 PotlatchDeltic is also starting to link nursery RGP test results to UI results. Different scoring methods are used, so this may prove difficult.

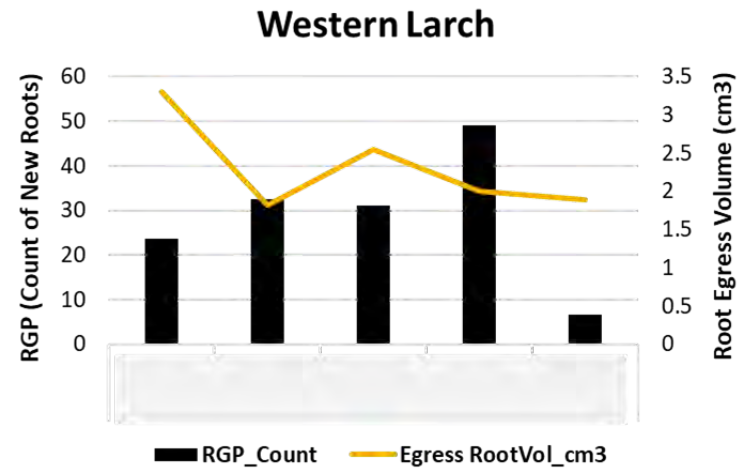
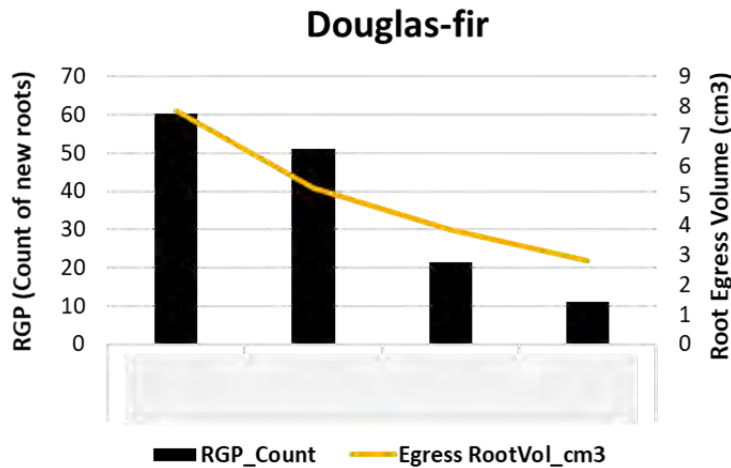


Outplanting of seedlings





RGP & Outplanted Root Growth



- Douglas-fir RGP correlated well with root egress during the first season after planting
- Relationship between RGP & root egress was less consistent for western larch



Nursery RGP Testing

- 🌲 Check with current nurseries to see if they offer RGP or Root Growth Capacity (RGC) testing on your seedlots.
- 🌲 Some nurseries do a pot test for RGP.
 - 🌲 Set up in a small greenhouse.
 - 🌲 Control temperature, lights and water.
 - 🌲 Typically, it is a 21-day test.
- 🌲 Seedlings scored on sliding scale from 0-5. The higher the number, the greater number new roots on seedlings.
- 🌲 Some nurseries do pot test with a pass/fail score.



Nursery RGP Testing





Nursery RGP Testing





Root Growth Potential (RGP) Testing

Species	Size (metric)	Date Received	Nursery Score	Average Root Count
DF	8	10-Dec		52.53
DF	8	1-Dec		49.73
DF	8	1-Dec		13.93
DF	8	2-Dec		57.93
DF	410A	4-Nov		24.07
DF	8	16-Dec		71.53
DF	411B	9-Dec	3.43	37.00
DF	411B	9-Dec	4.37	47.87
DF	411B	9-Dec	3.97	40.13
DF	8	10-Dec		33.33
DF	410A	16-Dec		20.20
DF	410A	21-Jan		33.20
DF	8	2-Dec		64.53
DF	8	16-Dec		47.53
DF	8	10-Dec		40.00
DF	8	2-Dec		51.27



How to integrate results? A case study.





How to integrate results? A case study:

- 🌲 Nursery issue identified during fall inspection.
 - 🌲 High seedling variability
 - 🌲 Poor roots
 - 🌲 Poor color
- 🌲 Discussed harvest standards and expectations.
- 🌲 Seedlings harvested in mid-January.
- 🌲 Delivered seedlings for RGP did not meet harvest standards.



How to integrate results? A case study:



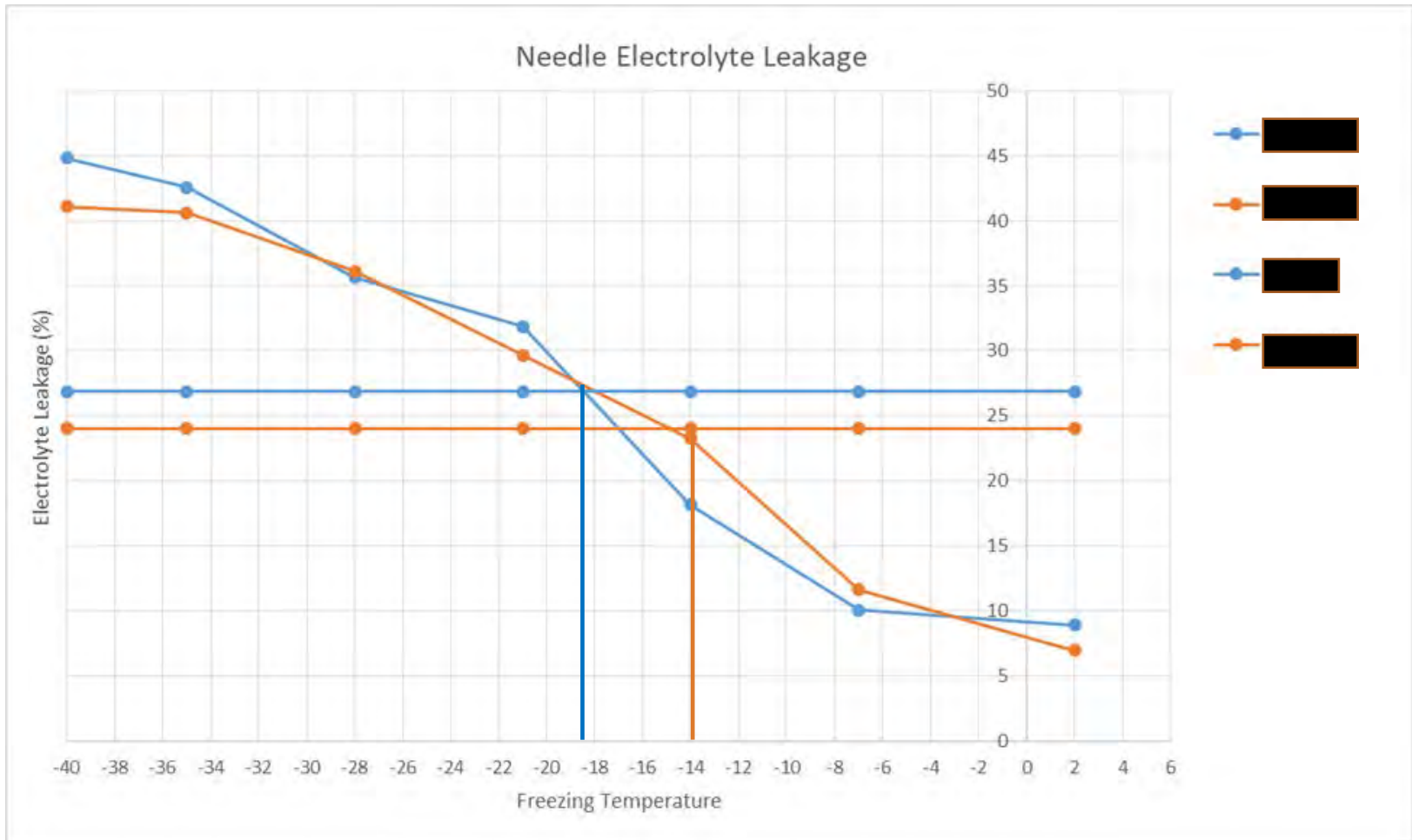


How to integrate results? A case study:



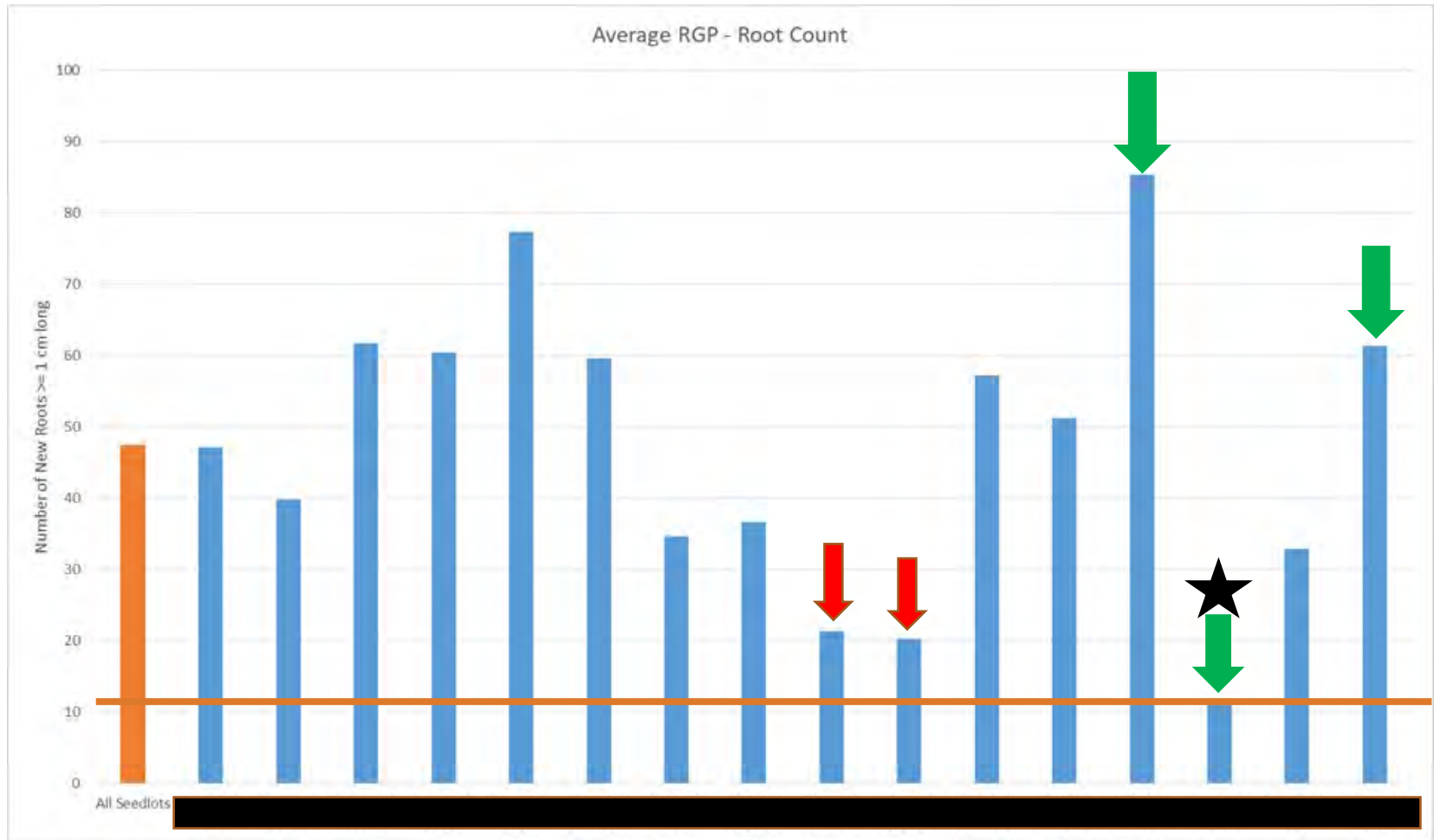


How to integrate results? A case study:





How to integrate results? A case study:





How to integrate results? A case study:

- 🌲 Douglas-fir seedlings from this nursery were planted in identified areas.
- 🌲 Box audits indicated only 82% of packed seedlings met minimum contract specifications.
- 🌲 Negotiated with nursery for partial refund on packing of seedlings that did not meet contract specifications.



Conclusions:

- 🌲 By working closely with your nurseries and testing seedlings:
 - 🌲 Potential issues are identified early.
 - 🌲 Seedling tests confirm issues and their severity.
 - 🌲 Provide time to adjust planting program based on test results.
 - 🌲 Annual testing provides good data for evaluation of your reforestation program.
- 🌲 Time of planting is not when nursery issues should be identified.



Conclusions:

- 🌲 Time of planting is not when nursery issues should be identified.



Conclusions:

**When will you
start testing
seedlings?**



Any questions?





Abbie A. Acuff
PotlatchDeltic
208-791-4618

Abbie.Acuff@PotlatchDeltic.com